# Study on Characteristics and Treatment Technology for JiYuan Landfill Leachate

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| その他（別言語等）のタイトル | ごみ処理場から排出される濾過液の特性と処理技術の研究 |
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# Study on Characteristics and Treatment Technology for JiYuan Landfill Leachate

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**Abstract**

Continuing industrial and commercial growth in many countries around the world in the past decades leads to rapid increase of both the municipal and industrial solid waste. Landfill is still the primary and convenient method to dispose municipal solid waste. However, a large amount of leachates will be generated inevitably from a landfill site, which has been treated as a major problem of landfill disposal of municipal solid waste. Landfill leachate is a high-concentrated organic wastewater in which complex components are contained. Surroundings will be polluted severely if leachate was discharged out of landfill without any treatment. Generation source and characteristics of waste leachate from Jiyuan landfill were studied, the results show that leachate includes mainly water contained in waste itself, water created by organism through aerobic and anaerobic decomposition, natural rain water and runoff. The conclusion was drawn that merge treatment and leachate injection are feasible in both technology and economy after testing its main component and analyzing several familiar treatment technologies such as biological technique, physical-chemical method, land treatment and group disposal techniques and so on.

Keywords: landfill leachate; component; treatment technology

## 1 INTRODUCTION

Amount of Urban garbage increases with a speed of about 8~10% for the rapid urbanization process in late ten years, and the predicted total value could reach 2.64 million tons in 2010, 4.09million tons in 2030, and 5.28 million tons in 2050[1]. Landfills is used widely because it has a lot of advantages for example lower cost, mature technique, easy management and so on, and investigation for urban garbage landfill in 329 cities show that the amount of urban garbage treated by this method account for about 87.5%[2]. As a product of landfill, leachate is a kind of high-concentration poison and harmful waste water for containing a mount of organic matter, ammonian, bacterial, parasite, etc[3]. So that it will pollute both underground and surface water, and other surroundings if it is discharged directly without any treatment. Thus, this paper will study characteristics of landfill leachate and its suitable treatment taking Jiyuan landfill leachate as example.

## 2 SOURCE AND CHARACTERISTICS OF JIYUAN LANDFILL LEACHATE

### 2.1 Source of leachate

Jiyuan landfill exists at Zaoshu ridge, Zhicheng town,Jiyuan city, which is 10km from Jiyuan city, and area is about 1,200,000 $m^2$. Its designed treatment amount is about 300 tons per day(110,000 tons per year), and the storage capacity is about 1,500,000 $m^3$. The landfill construct has used technologies of seepage-proofing, consolidation, overburdening and air

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**Table 1 physical and medical properties of Jiyuan urban garbage**

| time | Density (kg/m$^3$) | Water ratio% | pH | N% | P% | K% | Ash content |
|---|---|---|---|---|---|---|---|
| 2000 | 480.30 | 13.24 | 7.20 | 0.56 | 0.36 | 0.74 | 55.03 |
| 2001 | 462.10 | 15.65 | 7.10 | 0.62 | 0.38 | 0.97 | 52.57 |
| 2002 | 435.70 | 19.80 | 7.40 | 0.67 | 0.41 | 1.21 | 50.61 |
| average | 459.40 | 16.23 | 7.20 | 0.62 | 0.38 | 0.97 | 52.74 |

guiding. The urban garbage will be innocent treated Jiyuan landfill mainly treats the garbage frombefore put into landfill. Jiyuan city. Main medical segments are shown in Table 1. And garbage types are a lot, which include food, garden, paper, plastic, rubber, leather, textile, wood, metalwork, glass, ceramic, dust, brick bat, riprap, mud, and so on.

Jiyuan landfill leachate are composed of (1)mainly water contained in waste itself, (2)water created by organism through aerobic and anaerobic decomposition, through aerobic and anaerobic decomposition,(3)natural rain water and runoff, and recharging water. Raining is the main one of above four sources. The garbage will decompose, dissolve out, and ferment when they meet the water. That is the cause why there are a lot of organic nitrogen and many kinds of heavy metal in the leachate, in which there are 22 kinds of matter has been added in key –control list. One of them is carcinogen and 5 of them could contribute to the formation of cancers.

### 2.2 main component of landfill leathate

Landfill leathate component is always divided into following 4 classes. They are respectively (1) Organism. COD TOC, and $BOD_5$ are always used to measure its quantity, but some dangerous and small-amount organism contents for example phenol need be measured alone; (2) Common inorganic metals. For example Cd, Mg, Fe, Na, $NH_3$, $CO_3^{2-}$, $SO_4^{2-}$, $Cl^-$, and so on;(3) Trace metals. Such as Mn, Cr, Ni, Pb, etc.(4) Microorganism. Component of JIyuan landfill leathate is shown as Table 2(Cu,Cr and Mn are undected)

**Table 2 component of JIyuan landfill leathate**

| Pollution factor | pH | COD | Ni | Pb | Zn |
|---|---|---|---|---|---|
| contents | 8.33 | 840 | 0.04 | 0.08 | 0.01 |

### 2.3 features of landfill leathate

Component of landfill leathate is affected by component of garbage, local climate, hydrology, buried time, burying method, and so on, and it has following features:

(1) Concentration organism is high. The organicmatters in landfill leathate could be divided into three categories; they are fatty acid and humus with low molecular weight, carbohydrate with higher molecular weight, and Curling factor with middle molecular weight.
(2) Ammonian content is higher.
(3) Phosphorus, especially the dissolvable phosphate content is lower.
(4) Metal ion content is higher. landfill leathate consist of many kinds of metal ion, but their content depends on garbage component and buried time.
(5) Content of dissolvable solid is higher. the dissolvable solid content change with time, and reach peak value in 1.5~2.5 years. at the same time the leathate contain a large amount of dissolvable abio-salt like Na, K, Cl, $SO_4$, Fe and Mg. Then, the content will decrease till it reaches a stable level.
(6) Chroma of leathate is higher and is usually sandy, puce and black with heavy putrefactive odor.

## 3 COMMON TREATMENT TECHNOLOGIES OF LANDFILL LEATHATE

The investigation for 292 middle or large landfill show that there are 61% of total landfill has leathate treatment system, in which 49% of landfill treat the leathate before discharging them, but not yet reach the corresponding national standard. Other 12% of landfill do some treatment and the discharged water could reach 3-class standard. Leathate could bring face-source pollution and be divided into 3 methods including inside landfill treatment, outside landfill and combining treatment. Inside landfill treatment is to spray the leathate circling in landfill or set up an independent treatment system; outside landfill treatment is to add the leathate to the urban sewage and treat them at same time; and combining treatment is to add pretreated leathate to urban sewage and retreat them together with urban sewage. In total, common treatment technologies of landfill leathate include biological treatment, physiochemical treatment, land treatment and group technology, etc.

### 3.1 biological treatment

（1）Aerobic treatment

Aerobic treatment includes process of activated sludge process, aeration stabilization lagoon, biomembrane, biofilter and bio-fluidized bed. The practice of using activated sludge process at home and abroad shows that the method of lowering organism loading to enhance sludge concentration has a satistring effect.

（2）Anaerobic treatment

Anaerobic treatment has advantages of less energy, simple operation, lower running cost, lower sludge ratio and enhancing biochemical ability of wastewater,

so it can be used for landfill leathate with higher concentration of organic matters and bad biochemical ability. And the methods include UASB, anaerobic touching pool, up-flow anaerobic sludge blanket and so on.

（3）Aerobic and Anaerobic combine treatment

For high concentration landfill leathate, it is difficult to reach discharge standard only by adopting anaerobic treatment, so it need aerobic treatment also, which is called as Aerobic and Anaerobic combine treatment

### 3.2 physico-chemical treatment

Physico-chemical treatment method includes coagulating sedimentation, charcoal absorption, chemical oxidation, ion exchange, Reverse Osmosis,

electrodialysis, Air stripping, ultrafiltration, and so on, in which physico-chemical treatment method is not influenced by variance of water quality and quantity, and quality of discharged water is stable comparably specially for landfill leathate which is difficult to be treated by biology treatment method for containing less ratio of BOD and COD (0.07~0.2). However, coagulating sedimentation need stable water quality, and wide variance of water quality will cause a unstable coagulating effect and a lot of chemical sludge. charcoal absorption, Oxidation by ozone, reverse osmosis and ultrafiltration have good Treatment effects, but they are expensive too. So, physical-medical treatment is only used as pretreatment or combining other methods in practice.

### 3.3 land treatment

Land treatment uses mainly physical, chemical and biochemistry function of soil and conludes two method of constructed wetland and tificial recharge. It can reduce leathate production through transforming organism and ammonia and avaporation by using the self adjust-control mecnanism and composite purify function of terrestrial ecosystem of soil-microbe-plant.

Constructed wetland has advantages of lower cost, convenient management, and so on. But it changes with seasons and can only deal with water containing lower-concentration organisorganic matters. So, it can be used in south zone where plant has a longer period and grows egonic, but it is not suitable to be used in north zone.

Tificial recharge treat landfill as a biology filtering bed filled with waste. When leathate is recharged into landfill, it pass through overburdening soil layer and waste layer orderly and degradation and interception will happen to leathate by physical, chemical and biochemical function.

## 4 DISCUSS ON JIYUAN LANDFILL LEATHATE TREATMENT

Leathate collecting system of jiyuan landfill is used to collect and transport leathate from landfill for further treatment. Height of standing water on compound backing should be sure to be less than 30 cm and which can thus lighten the population to groundwater. Leathate-collecting system include leathate discharge layer, collecting channels, multiaperture collecting pipes, collecting pool, enhancing pipe, pump and leathate storing pool. Landfill bottom should be made as a series of slope-shaped steps for stopping the leathate to storage on the landfill bottom. Outline bordor and structure of landfill bottom must enable gravity water flow to lowest point, and both two-stage leathate collecting system should feed the above requirement. But Jiyuan landfill leathate is less, so there is no need to set up special leathate gathering unit, we can use following two methods to deal with leathate.

### 4.1 combining treatment

We can use special cars to transport leathate of Jiyuan landfill to Jiyuan waste treatment plant and treat them with waste water. This method has been used from the time that the landfill was set up to 2006. But it is expensive and has some other problems. Combing treatment could enhance slightly biodegradability of leathate, but the problems led by adding the leathate can not be ignored, it mainly includes that accumulation of heavy metal in biology sludge will affect the application of waste matter in agriculture, and most harmful, poisonous and hard to be degraded matters like TOX can not be removed, they are only transported into discharged water in the dilution process, which will further threaten the environment

### 4.2 recirculation treatment

Recirculation treatment is used in practice widely abroad but comparably less home. In fact, recirculation treatment treats landfill as a biology filtering bed fill with waste, and has function of accelerating landfill stability. When leathate is put back into landfill, it will pass through overburden soil layer and waste layer and will be degraded or intercepted by a series of biology, chemistry and physical reaction. Recirculation treatment effects depend on recirculation style, quantity, OLR, frequency, and waste grain size, porosity. Interrelated research abroad and home shows that leathate recirculation has following advantages: (1) accelerating stability of leathate quality and water quantity reduction by surface evaporation and biology degradation, (2) accelerating stability of landfill waste component, (3) lessening the maintenance period and cost after closure of landfill, and the maintenance cost is only 45% of leathate solely treatment by estimate, and (4) accelerating landfill gas yield, and enhancing the recycling economical viability. But recirculation also has some problems：(1) The circulation of leathate in waste layer leads to unceasing accumulation of ammonia, heavy metal, organism acid and other minerals, and adoption of heating, pH value adjustment, inoculation will raise operating cost. (2) Not all

Leathate after recirculation can reach first or second grade of national standards, they need further treatment.(3) The environment, healthy and safety problem such as fetor created in the spraying process of recirculation and acceleration of landfill gas output and productive rate need to be solved. (4) High-quantity suspended matter or microorganism excess reproduction will lead to surface blockage, so that it need a pretreatment for TSS in leathate or lose the recirculation surface regularly. (5) Mature production engineering and operational experience is still not enough to deal with recirculation at different stages, so that problem is easy to happen in practical operation.

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ごみ処理場から排出される濾過液の特性と処理技術の研究

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概要

全世界の多くの国々において、過去 10 年間に渡る産業と商業の連続的な成長は、都市と産業の廃棄物の急速な増加をもたらした。ごみ処理場の存在は、都市廃棄物の処分地として、一次的で簡便な方法である。しかしながら、ごみ処分場からは必然的に非常に大量の濾過液が発生し、それは都市ごみ処分の主要な問題として取り扱われて来ている。ごみ処理場から排出される濾過液は複雑な成分を含む、高濃度有機廃液である。もし濾過液が何らの処理もなく、ごみ処理場から排出されたならば、その周辺地域は激しく汚染されるであろう。JiYuan ごみ処理場からの濾過廃液の発生源と特性について研究が行われた。その結果、以下のことが示された。濾過液はそのもの自体に含まれる水分を主に含んでおり、その液は好気性と嫌気性の分解、天然水と地表を流れる雨水を通して、有機物により作られる。溶解処理と濾過液注入が技術と経済性の両面において、主な構成要素の試験と生物学的技術、物理化学的方法、土地処理とグループ処理技術等のような良く知られた 2、3 の処理技術を解析した後、実行可能であることを結論付けた。

Keywords: landfill leachate; component; treatment technology

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